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Original Article

An 11-year experience with ovarian surgery during pregnancy

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Abstract

Background: The management of ovarian tumors during pregnancy can be challenging because of the risk of fetal wastage and the possibility of surgery-related complications, or a delayed diagnosis of a possibly lethal disease or malignancy. The aim of this study was to study the characteristics and outcomes of pregnant women undergoing surgical intervention for ovarian tumors during pregnancy.
Methods: We reviewed the data of 102 pregnant women who underwent ovarian surgery between 2000 and 2010 at Taipei Veterans General Hospital, Taiwan. Data subject to analysis included gestational age at the time of surgery, complications, surgical and pathological findings, and the outcome of pregnancy.
Results: Fifty-two women who underwent surgery were excluded, whether by cesarean section, during the *postpartum* period or during simultaneous abortion surgery. Ultimately, the data of 50 patients were analyzed. Almost all patients ($n = 46$, 92%) were asymptomatic and underwent elective surgery. Frequently, this surgery was done in the second trimester ($n = 35$, 70%). We determined that teratoma (26%), mucinous cystadenomas (20%), and endometriomas (16%) were the three most common pathological findings. Nonspecific ovarian tumors were common (28%), including seven corpus luteum cysts, six simple cysts, and one paratubal cyst. Two women were diagnosed with malignant ovarian tumors, but both were metastatic and the primary site was the colon. Ten women underwent laparoscopic surgery. General anesthesia was used in four patients, and all underwent emergency exploratory laparotomy. There was no surgery-related complication or instance of preterm labor.
Conclusion: In our study cohort, surgical intervention during pregnancy was safe, since neither surgical approach, such as exploratory laparotomy or laparoscopic surgery, nor anesthesia methods, for example general anesthesia or spinal anesthesia showed negative impact on the pregnancy outcomes. Reported cases of malignant ovarian tumor are still rare, thus, the possibility of metastatic tumor should be considered first.

Keywords: laparoscopy; laparotomy; ovarian tumor; pregnancy

1. Introduction

Although ovarian cyst or tumor during pregnancy is relatively common, the majority of them spontaneously disappear during customary medical follow-up.[1] Only a few tumors typically persist and require further surgical intervention. However, the management of ovarian tumors during pregnancy can be challenging, not only for the obstetricians but

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also for the pregnant women. The main concerns affecting patient medical management include the risk of fetal wastage,[2] the possibility of surgery-related complications, or a delayed diagnosis of a possible lethal disease or malignancy.[3] Therefore, it is sometimes problematic to make the decision to intervene surgically, even though it is related to the nature of the emergency, such as torsion or rupture, tumor size, potential risks of complications, possibility of malignancy,[5] gestational age at the time of diagnosis, and maternal age.[6] To minimize the above-mentioned risks, the assistance of a well-trained team in a tertiary hospital, including obstetricians, gynecologists, pediatricians, anesthetic experts, and other specialists, is always advantageous.

In this study, we retrospectively reviewed 50 patients who underwent surgical intervention during pregnancy over a period of 11 years, to assess the surgical effects and characteristics of ovarian tumors during pregnancy.

2. Methods

Between 2000 and 2010, there were 17,586 deliveries at Taipei Veterans General Hospital – a medical-school-associated medical center in Northern Taiwan. Of these deliveries, 102 involved ovarian surgery during pregnancy and the intrapartum period. Most patients were symptom-free and a few had nonspecific and mild symptoms, for example, abdominal fullness. For those patients with asymptomatic ovarian tumors during pregnancy, the indications for preventive surgery were individualized, based on the following considerations: tumor size, growth pattern, morphology in imaging studies, tumor location, and the patients' or doctors' attitudes. Patients with a significant symptom, such as torsion or rupture, were treated with emergency surgery.

Preoperative patient evaluation included ultrasound examination, serum biochemistry, tumor markers, complete blood count, and electrocardiography, as well as consultations with anesthesiologists and neonatologists. Routine cardiotocography (CTG) – continuous electronic fetal heart rate monitoring – was performed before and 48 hours after the operation. Progesterone, β2 agonist, or magnesium sulfate tocolytic agents were used with all patients who underwent surgery during pregnancy, regardless of their gestational age.[8] Tocolytic treatment was started on the day before surgery and continued for 24–48 hours postoperatively to prevent preterm labor. Data collected included age, gravidity, parity, gestational age (at diagnosis, disposition, and delivery), complications related to pregnancy, operative and pathological findings, methods of anesthesia, and pregnancy outcome. Approval for the study was obtained from the local ethics committee (VGHIRB 98-11-02).

3. Results

Thirty-four women who underwent surgery during cesarean section or the *postpartum* period and 18 who underwent simultaneous abortion surgery in the early trimester were excluded from the analysis. The remaining 50 patients were included. The age distribution of this study cohort did not differ from that of the other women giving birth within the same period in the same hospital (data not shown). The majority of patients (37/50, 74%) were treated in the second trimester, and 12 underwent ovarian surgery in the first trimester (Fig. 1). The pathological diagnoses of these remaining patients included mature cystic teratoma (13/50, 26%), mucinous cystadenoma (10/50, 20%), endometriosis or chocolate cyst (8/50, 16%), corpus luteum ($n = 7$), simple cyst ($n = 6$), serous cystadenoma ($n = 2$), metastatic ovarian carcinoma from the colon ($n = 2$), and paratubal cyst ($n = 1$) (Table 1).

Five women (10%) had a tumor size < 5 cm, 36 (72%) between 5 cm and 10 cm, five (10%) between 10 cm and 15 cm, and four (8%) > 15 cm. The relationship between tumor size and pathological diagnosis is also described in Table 1.

Forty-six women were treated by elective surgery during pregnancy and four underwent emergency exploratory laparotomy under general anesthesia for acute abdomen after failure of conservative treatment. All surgical findings were torsion and pathological findings were teratoma (2/4, 50%) and corpus luteal cyst (2/4, 50%). The size of these four tumors with torsion ranged from 5 cm to 10 cm (median, 7.8 cm).

Table 2 shows the characteristics of the women undergoing ovarian surgery during pregnancy. Cystectomy was performed in 27 patients (54%), and oophorectomy in 23 (46%) (Table 3). Only five patients (10%) were given regional (spinal) anesthesia, and all underwent elective exploratory laparotomy.

4. Discussion

The treatment of ovarian tumors in pregnancy is still challenging, because the treatment decision is often associated with unacceptable errors, for example, the sometimes unjustified termination of pregnancies, or the choice of an inadequate strategy for treatment of a tumor because of fear of compromised fetal health or cancer risk.[9,10] In addition, most pregnant women visit obstetricians from the early weeks of gestation, and ultrasonographic evaluation is now widely used; both of which result in not only an increased detection rate of

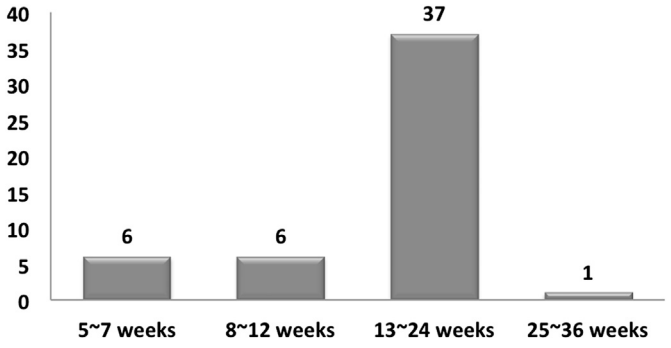

Fig. 1. Distribution of women undergoing ovarian surgery based on different trimesters.

Table 1
Relationship between tumor size and histological diagnosis in pregnant women undergoing ovarian surgery.

	Tumour size (cm)				
	<5	5–10	10–15	15–20	Total
Mature cystic teratoma	1	10	2	0	13
Mucinous cystadenoma	0	1	6	3	10
Endometriosis	1	5	2	0	8
Corpus luteal cyst	4	3	0	0	7
Simple cyst	0	3	1	2	6
Serous cystadenoma	0	1	1	0	2
Paratubal cyst	0	1	0	0	1
Cystadenofibroma	0	1	0	0	1
Metastatic carcinoma	0	1	1	0	2
Total	6	26	13	5	50

adnexal masses during pregnancy over time,[11] but also the detection of asymptomatic and clinically unapparent lesions.[12] Furthermore, this detection rate is the highest during the first trimester, as shown by Ueda and Ueki, who detected 90.3% of tumor-like lesions and 78.8% of benign tumors before the 10th gestational week.[13] Whitecar and colleagues have reported that the majority of the above-mentioned masses in the first trimester are corpus luteum or other functional cysts that usually resolve by the 16th gestational week.[14]

Thus, it is widely recommended that these masses should be managed conservatively, because the majority of ovarian tumors in pregnant women spontaneously disappear during follow-up[1]; that is to say, that only a few tumors are persistent and need further surgical intervention. In 2005, Schmeler and colleagues tried to estimate whether delaying surgery affects the risk of adverse maternal and fetal outcomes in patients diagnosed with an adnexal mass during pregnancy.[15] They have concluded that close observation is a reasonable alternative to antepartum surgery in patients with an adnexal mass during pregnancy in selected cases.[15] In addition, Katz et al's study of a high-risk group (teratoma during pregnancy) failed to identify an unfavorable prognosis with these tumors, because complications are extremely rare.[16] Therefore, these tumors should be managed conservatively, if possible, with routine ultrasonography follow-up during pregnancy.[16]

Table 2
Characteristics of ovarian surgery during pregnancy.

Characteristics	Mean ± standard deviation
Age (y)	30.0 ± 4.3
Body mass index (kg/m^2)	22.1 ± 2.6
Blood loss during surgery (mL)	159.7 ± 176.9
Gestational age at surgery	15 wk and 1.3 d ± 8 wk and 1.0 d
Surgical time (min)	95.2 ± 56.6
Hospitalization stay (d)	8.4 ± 5.3
Gestational age of delivery	38 wk and 3.3 d ± 1 wk and 3.7 d
Birth weight of fetuses (g)	3113.0 ± 300.5
Sex of fetus	Male: 30
	Female: 20
Apgar score at 1 min	7.7 ± 0.9
Apgar score at 5 min	8.9 ± 0.4
Delivery methods	Vaginal delivery: 40
	Cesarean section: 10

Table 3
Comparison of exploratory laparotomy and laparoscopic surgery during pregnancy.

Characteristics	Exploratory (n = 40)	Laparoscopy (n = 10)	Total (%)
Cystectomy	23	4	27 (54)
Oophorectomy	17	6	23 (46)
General anesthesia	35	10	45 (90)
Regional anesthesia	5	0	5 (10)
Elective	36	10	46 (92)
Urgent	4	0	4 (8)

However, it is also important to confirm resolution of the mass or to excise it to make a pathological diagnosis. This results in a great deal of controversy because it is hard to make a decision to select good candidates at appropriate times to undergo ovarian surgery in pregnant women.

Nearly all studies have found that cystic teratoma is the most common tumor removed during pregnancy (up to 40–50%), but there is no doubt that the corpus luteum of the pregnancy and simple cysts are still frequently seen in the pathological diagnosis of ovarian tumor during pregnancy, ranging from 11% to 41%.[15–17] After careful evaluation of these reports, it was found that not all of the tumors were asymptomatic. For example, in our previous study, the final pathological diagnoses of the pregnant women undergoing emergency laparotomy at the first trimester showed that 50% (8/16) had functional cysts.[17] In addition, up to 42.9% (3/7) of these women were complicated with spontaneous abortion.[17]

An acute abdomen, in particular, might be one of the most urgent situations, and may be accompanied with early fetal loss if ovarian torsion occurs during the first trimester.[1] In fact, the most frequently seen and serious complication of ovarian tumor during pregnancy is torsion; rupture of the tumor is rare.[18] It has been reported that the torsion rate of adnexal masses during pregnancy is 10–15%; however, the majority of cases (ovarian torsion during pregnancy) are seen gestational weeks 8–16, at which point the uterus grows faster.[18] Chang and colleagues have researched the topic of ovarian torsion during pregnancy, and found that the majority of cases (75%) occurred in the first trimester and 30% were mature teratomas.[19] In 2009, the same group studied 174 patients and showed that only 5.9% of ovarian torsions occurred after 20 weeks, suggesting a higher risk of ovarian torsion before 20 weeks gestational age[20]; this was also demonstrated in another study.[11] In addition, the highest risk of ovarian torsion exists between the 10th and 17th week of gestation (60%).[19] Finally, ovarian torsion does not always occur with pathological findings; that is to say, the percentage of functional cysts (corpus luteum cyst and follicular cyst) is high: for example, 35% in the study of Chang and colleagues[19] and 41% in another study.[11]

Another issue worthy of our attention is the possibility of malignant ovarian tumors, because these tumors hold 2–6% of adnexal masses detected during pregnancy.[21] Many scoring systems used to distinguish the differences between malignant ovarian tumors and other benign situations have been

extensively reviewed in the literature, and include malignancy characteristics, such as the size of an adnexal mass (total volume > 50 mL), echogenicity (presence of a solid component), internal borders (wall thickness or irregularity), presence of septations (thick) and papillary projections (defined as solid projections into a cyst cavity from a cyst wall of >3 mm in height), and resistance Doppler waveform with a pulsatility index < 1.0 or a resistance index < 0.4–0.8.[23,24,26] However, this issue is not further discussed here; we have discussed only tumor size, which is a subject of controversy when we consider whether these tumors should be removed during pregnancy. Two studies have supported a cutoff value of 10 cm, because tumor diameters ≥ 10 cm at the initial diagnosis during pregnancy had a higher risk of malignancy.[21] However, if we consider the possibility of ovarian torsion, the cutoff value of tumor size might range from 6 cm to 8 cm, because tumors of this size have a significantly higher risk of torsion.[19]

Finally, we found no pregnant women who were complicated with spontaneous abortion if the ovarian surgery was performed on an elective basis, even though the final pathology was corpus luteum, based on our previous studies[17] and the current study. Therefore, we favor the use of prophylactic surgery (preferably the laparoscopic approach) to remove mature teratomas at week 8 of gestation, to minimize the risk of fetal loss during pregnancy without contraindication, because we found no fetal loss after week 8 of gestation in elective surgery.[5] In addition, teratoma components of ovarian masses that were <5 cm did not seem to escape the risk of torsion.[17] An urgent operation might increase the risk of fetal loss before the 10th week of gestation, especially in cases of mature teratoma.[17] Of greater importance, however, is that the diagnosis of mature teratoma is easy through high-resolution ultrasound in early pregnancy; this type of tumor teratoma is prone to torsion during the first trimester.[1]

Therefore, questions regarding how or when to treat those pregnant women with asymptomatic, nonsuspicious cystic ovarian masses, and who should be treated with surgical intervention for adnexal masses during pregnancy remain unanswered. Providing answers to these questions is no simple matter, and there is substantial controversy if issues such as anesthesia risk, fetal loss, fear of malignancy, and anxiety regarding overmanipulation of the functional ovarian cysts (which often spontaneously disappear) are taken into consideration.[5] No one answer can totally satisfy all clinicians, or persuade those pregnant women involved. Some suggestions from our study include the need to maintain regular patient follow-up with high-resolution ultrasonography, and attention to clinical symptoms and other signs for those pregnant women with an accidental finding of ovarian tumor; any medical management strategy should not have a negative impact on the wellbeing of either the mother or the fetus. If possible, the treatment of every pregnant woman, and by extension every woman of childbearing age, should include a wider reflection on how to preserve the pregnancy or subsequent fertility, or both.[28]

We excluded 18 women from the analysis because they underwent ovarian surgery, simultaneous with either medical or surgical abortion therapy.[29] Although some of the women had unexpected pregnancies, doubtless some of them were afraid of the teratogenic effects and unpredictable risk to the fetus associated with general anesthesia and ovarian surgery, ultimately resulting in the decision to abort. Twelve women in this study underwent ovarian surgery in the first trimester, and four (33.3%) requested amniocentesis, in part due to the above-mentioned reasons.[30] It is worth noting that none of them were indicated for amniocentesis secondary to advanced maternal age, which is a major reason why pregnant women ask for amniocentesis.[32,33]

All newborns in this study ($n = 50$) were born essentially normal, suggesting that neither anesthesia nor gestational age at the time of ovarian surgery affected the fetuses, although the development of the fetuses after birth was not really evaluated in this study. However, based on a review of the literature,[34–38] there are no known teratogenic effects from the use of commonly administered anesthetic agents at standard concentrations at any gestational age.[39] A review of nonobstetric surgery from the Swedish Health Registry involving pregnant women between 4 and 20 gestational weeks, including 2181 laparoscopies and 1522 laparotomies, found that neither congenital malformations (5.0% in the laparoscopy group and 4.1% in the laparotomy group) nor still births and neonatal deaths (1.3% and 1.7%, respectively) were significantly increased compared to the normal population,[37] suggesting anesthesia between 4 and 20 gestational weeks was safe.

Besides the teratogenic effects of anesthesia, other fetal complications of ovarian surgery during pregnancy may include those related to the development of changes in fetal hemodynamics, leading to the common practice of fetal monitoring during surgery. Documentation of fetal wellbeing before and after the surgical procedure, including ovarian surgery, can be accomplished through a reassuring electronic fetal heart rate monitoring or biophysical profile.[40,41] By contrast, the need for intraoperative fetal heart rate monitoring is more controversial, because little is known about normal fetal physiological responses to maternal anesthesia and surgical stress.[39] It is relatively difficult to establish a confident threshold point where it would be obviously necessary to intervene in the setting of a fetal heart rate monitoring mechanism.[39] Furthermore, it is difficult to set up CTG when the pregnant women (as patients) are undergoing abdominal surgery. A large systemic review of 224 articles also found that there were no fetal heart rate abnormalities in pregnant women during nonobstetric surgery.[38] However, the concerns of pregnant women and obstetricians regarding fetal wellbeing are always present. The American College of Obstetricians and Gynecologists states that fetal heart rate monitoring during nonobstetric surgery in pregnant women should be evaluated on an individual basis, and according to the physician's judgment.[42]

In our study, the fetal status was not monitored during ovarian surgery, although CTG was used routinely before and after operation. The use of CTG after operation was based on the observation of an increased risk of low-birthweight infants (< 1.5 kg) due to prematurity and intrauterine growth

restriction and infant deaths within 7 days of birth in pregnant women who were treated with nonobstetric surgery during pregnancy.[34] The routine use of CTG after a surgical procedure in pregnant women might help to predict the occurrence of preterm labor. With CTG results as a basis, the use of tocolytic agents can be immediate and prompt, because their use in pregnant women undergoing nonobstetric surgery is also controversial. There are no data to date demonstrating a benefit of the use of tocolytic agents for pregnant women with nonobstetric surgery during pregnancy.[39] A systemic review also failed to support the benefits of the routine use of prophylactic tocolytics for pregnant women who need nonobstetric surgery during pregnancy.[36] By contrast, the use of tocolytics should be reserved for circumstances in which evidence of preterm labor is apparent.[36] However, in an effort to minimize the risk of low-birthweight infants and early neonatal death,[34] we continue to favor the use of prophylactic tocolytic agents in the perioperative setting. In this study, we administered tocolytic agents routinely, whether progesterone, β2 agonist, or magnesium sulfate, for all women who underwent ovarian surgery, regardless of gestational age, and the outcomes appeared to be positive. None of the pregnant women suffered preterm labor or complications attributable to tocolytic treatment.

The efficacious selection of tocolytic agents would typically depend on the experience of the clinicians, and the clinical conditions of the pregnant women. These tocolytic agents can be administered either before or immediately after surgery, and continued postoperatively for 24 hours or 48 hours therapy. No prospective or randomized studies have demonstrated the superiority of one type of tocolytic agent over the others.[8]

There are many important issues regarding the characteristics of the ovarian tumor during pregnancy. First, the frequency of occurrence of teratoma is common, and contributes to the high risk of a surgical emergency during pregnancy, secondary to torsion. This suggests the need for a routine adnexal evaluation prior to conception, and surgical intervention before conception should be considered. Second, functional cysts, including follicular cysts, simple cysts, or paraovarian or paratubal cysts are also common, and are not always free of risk; there were two cases of cysts complicated with acute abdomen during pregnancy in our study. Third, the risk of malignancy is low during pregnancy, as demonstrated by the fact that only two women in our study had malignant ovarian tumors. However, as also seen in this study, the presence of a history of malignancy, especially gastrointestinal tract malignancy, should prompt medical consultation prior to conception. In addition, careful evaluation before conception and during pregnancy should be emphasized, and any new ovarian growth should be actively managed. Fourth, tumor size is important. When the tumor is $>$ 10 cm, surgical intervention can be considered. However, surgery can be delayed for those tumors $<$ 5 cm. Nonetheless, if the tumor is between 5 cm and 10 cm, it is difficult to make a recommendation, although the risk of torsion is especially high in tumors of this size. In terms of surgical methods for ovarian tumor during pregnancy, either laparotomy or laparoscopy is safe for the mother and fetus. In addition, there is no difference in outcome for women treated with general or regional anesthesia.

In conclusion, our results demonstrate that ovarian surgery is relatively safe for both mother and fetus, and can be completed through either laparotomy or laparoscopy with general or regional anesthesia. Early surgical intervention for ovarian teratoma in pregnancy is still recommended when ultrasound detects this type of tumor, regardless of gestational age. For pregnant women with a history of malignancy, any adnexal mass lesion should be actively managed.

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